SLOVENSKI STANDARD
SIST EN 12812:2004

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Nosilni odri – Zahtevane lastnosti in projektiranje

Falsework - Performance requirements and general design

Traggerüste - Anforderungen, Bemessung und Entwurf

Etaiements - Exigences de performance et méthodes de conception et calculs

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Falsework - Performance requirements and general design

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This European Standard was approved by CEN on 10 December 2003.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 12812:2004) has been prepared by Technical Committee CEN/TC 53 “Temporary works equipment”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2004, and conflicting national standards shall be withdrawn at the latest by December 2004.

No other international organisation has been involved.

This European Standard is one of a package of standards that includes also EN 12810-1,EN 12810-2, EN 12811-1, EN 12811-2, EN 12811-3, EN 12813.

This European Standard does not replace any other European Standard.

This European Standard was prepared as part of a group, see above. It gives some information about products covered by:

— scaffold tube in accordance with EN 39;

— scaffold couplers in accordance with EN 74;

— adjustable telescopic props in accordance with EN 1065.

The standard is not mandated. However cognisance of two European Directives should be taken. These are:

Council Directives 89/391/EEC and 92/57/EEC.

The Annexes A and B are informative.

This document includes a bibliography

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

Most falsework is used:

— to carry the loads due to freshly poured concrete for structures until these structures have reached a sufficient load bearing capacity;

— to absorb the loads from structural members, plant and equipment which arise during the erection, maintenance, alteration or removal of buildings or other structures;

— additionally, to provide support for the temporary storage of building materials, structural members and equipment.

This European Standard gives performance requirements for those who specify and use falsework and gives methods to design falsework to meet those requirements. Clause 9 provides design methods. It legitimizes simplified design methods for falsework made of tube and couplers already successfully in use. The information on structural design is supplementary to the relevant structural Eurocodes.

The standard describes different design classes. This allows the designer to choose between more or less complex design methods, while achieving the same level of structural safety.

Because European Standards for materials do not exist to support the standard fully, it has been prepared permitting equivalent national standards to be used. Publication of a European Standard always results in the withdrawal of equivalent national standards.

Provision for specific personal safety matters is dealt with in EN 12811-1:2003 and other documents.

1 Scope

This European Standard specifies performance requirements and limit state design methods for two design classes of falsework.

It sets out the rules that a designer has to take into account to produce a safe falsework structure.

It also provides information for the person who requires falsework to support a "permanent structure" and who needs to commission its design or supply.

This European Standard also gives information on foundations.

This European Standard does not specify requirements for formwork, although formwork may be a part of the falsework construction. Nor does it provide information on access and working scaffolds, which is given in EN 12811-1:2003.

This European Standard does not provide information about site activities. It does not provide information about the use of some standardized products, including beams conforming to EN 13377 and props conforming to EN 1065.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 74, *Couplers, loose spigots and base-plates for use in working scaffolds and falsework made of steel tubes — Requirements and test procedures*.

EN 1065:1998, *Adjustable telescopic steel props — Product specifications, design and assessment by calculation and tests*.

EN 1990, *Eurocode — Basis of structural design*.

ENV 1991 (all parts including EN 1991-1-1, EN 1991-1-2, prEN 1991-1-3 and prEN 1991-2), *Eurocode 1 — Basis of design and actions on structures*.

ENV 1992 (all parts), *Eurocode 2 — Design of concrete structures*.

ENV 1993 (all parts), *Eurocode 3 — Design of steel structures*.

ENV 1994 (all parts), *Eurocode 4 — Design of composite steel and concrete structures*.

ENV 1995 (all parts), *Eurocode 5 — Design of timber structures*.

ENV 1996 (all parts), *Eurocode 6 — Design of masonry structures*.

ENV 1997 (all parts), *Eurocode 7 — Geotechnical design*.

ENV 1998 (all parts), *Eurocode 8 — Design provisions for earthquake resistance of structures*.

ENV 1999 (all parts), *Eurocode 9 — Design of aluminium structures*.

rEN 12811-1:2003, *Scaffolds — Performance requirements and general design*.

EN 12811-3:2002, *Temporary works equipment — Part 3: Load testing*.

EN 12813, *Load bearing towers of prefabricated elements — Methods of particular design and assessment*.

EN 12810-1:2003, *Facade scaffolds made of prefabricated components — Part 1: Product specification*.

DIN 18218, *Pressure of fresh concrete on vertical formwork*.

C E Clear and T A Harrison. *Concrete pressure on formwork*. CIRIA Report No. 108.London Construction Industry Resarch and Information Association

Manual de Technologie: Coffrage; CIB-FIB-CEB 27-98-83.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions in ENV 1993-1 and the following apply.

3.1
brace
component connecting two points of a structure to help stiffen it

3.2
design class
class that defines the extent of design for falsework

3.3
falsework
temporary support for a part of a structure while it is not self-supporting and for associated service loads

3.4
formwork
part of temporary works used to give the required shape and support to in-situ concrete

3.5
foundation
sub-structure needed to transmit loads into the ground

3.6
kentledge
material placed on a structure to provide stability by the action of its dead weight

3.7 imperfections

3.7.1
imperfection
divergence from the theoretical when erected ready for use

3.7.2
bow imperfection
initial out of true before loading

NOTE A bow imperfection can occur both in an individual member and in the complete tower or modular beam assembly. It arises because the member is not straight, is manufactured not straight or members are assembled out of alignment.

3.7.3
sway imperfection
out of true before loading in an erected structure, measured as an angle

NOTE This is the value for design purposes and may be more than the erection tolerance.

3.8
modular truss beam
longitudinally extensible beam made from a series of units capable of assembly to create various lengths

3.9
modular column
compression member assembled from components of various lengths, with adjustment means at one or both ends

3.10
node
theoretical intersection point of members

3.11
sway
angular movement of a column or other structure caused by the application of load measured as an angle

4 Design classes

4.1 General

The design shall be in accordance with one of three classes: A, B1 and B2.

NOTE The classes are identified as follows:

a) Class A: Falsework where the structural integrity is derived from a knowledge of the structural performance of components of the structure, such as adjustable props or formwork equipment. The structural performance of these components is individually rated. Capability to withstand vertical and horizontal loads is determined from experience and established good practice.

b) Class B: Falsework where a complete design is undertaken. This class has two sub-classes,see 4.3.

4.2 Design class A

Class A covers falsework for simple constructions such as in situ slabs and beams.

Class A shall only be adopted where:

a) slabs have a cross-sectional area not exceeding 0,3 m^2 per metre width of slab;

b) beams have a cross-sectional area not exceeding 0,5 m^2

c) the clear span of beams and slabs does not exceed 6,0 m;

d) the height to the underside of the permanent structure does not exceed 3,5 m.

The design shall be in accordance with Clauses 5 and 7.

4.3 Design class B

4.3.1 Class B1

The design shall be in accordance with the relevant European structural design standards in the Eurocode series (EN 1990, ENV 1991 to ENV 1999) and additionally with 9.1.1, 9.1.2.1, 9.1.3, 9.3.3 and 9.4.1 of the present standard.

NOTE It is assumed that the erection will be carried out to the level of workmanship appropriate for permanent construction.

4.3.2 Class B2

The design shall be in accordance with Clauses 5, 6, 7, 8 and 9, with the exception of 9.1.2.1, 9.3.3, 9.4.1, and with the relevant European structural design standards in the Eurocode series (EN 1990, ENV 1990 to ENV 1999). Where there is a conflict, the provisions of the present standard shall take precedence.

NOTE Attention is drawn to the simplified methods given in 9.3 and 9.4 and to the requirements for drawings and other documentation given in 9.1.2.

5 Materials

5.1 General

Only materials that have established properties and that are known to be suitable for the intended use shall be used.

5.2 Basic requirements for materials

5.2.1 If a European, international or national standard exists in which there is design data for a particular material or item of equipment, the material or equipment shall conform to the requirements of that standard. The requirements of European Standards shall take precedence.

NOTE See the relevant national Foreword.

5.2.2 Materials and equipment shall have had their relevant properties established by testing (see 9.5.2) where these cannot be obtained from the standards referred in 5.2.1.

5.2.3 Rimming steel shall not be used.

5.3 Weldability

The steel used shall be weldable, unless structural members and components are not intended to be welded.

For example, castings may be used at node points.

NOTE Different steels require different welding techniques. In general, welding of unidentified steels should not be undertaken for structural work. Steelwork that has been repaired by welding may be used provided that the remedial work has been carried out in accordance with the appropriate standard. The type and grade of steel should first be identified.

The design shall not require any welding of aluminium to be undertaken on site.

6 Brief

The design shall be based on a brief containing all necessary data including information on erection, use, dismantling and loading.

NOTE 1 Concrete is a typical example of loading.

NOTE 2 Adequate information about site conditions should be obtained and included in the brief. Particular points are:

— layout with levels, including adjacent structures;

— general appreciation of the parameters relating to wind load calculations for the local conditions;

— positions of services such as water pipes or electricity cables;

— requirements for access and safe working space;

— information about the ground conditions.

7 Design requirements

7.1 General

The structure shall be designed such that all the loads acting on it are carried into the subsoil or into a load-bearing substructure.

The available skill in erection and the ambient circumstances should be taken into account in the design.

Provision shall be made for the means of access for erection, use and dismantling. Reference should be made to EN 12811-1.

The design should be based on concepts and details the realization of which is practicable and which are straightforward to check on site.

7.2 Thickness of material

7.2.1 Thickness of steel and aluminium components

The nominal wall thickness shall be not less than 2 mm.

7.2.2 Steel scaffold tubes

Loose steel tubes to which it is possible to attach couplers conforming to EN 74 shall be in accordance with EN 12811-1:2003, 4.2.1.2.

Tubing for incorporation in prefabricated components to which it is possible to attach couplers conforming to EN 74 shall be in accordance with EN 12811-1:2003, 4.2.2.1 and with EN 12810-1:2003, Table 2.

7.2.3 Aluminium scaffold tubes

Loose aluminium tubes to which it is possible to attach couplers conforming to EN 74 shall be in accordance with EN 12811-1:2003, 4.2.2

7.3 Connections

7.3.1 Connection devices

Connections shall be designed such that they cannot be disconnected unintentionally when in use.

Vertical spigot connections between hollow sections in compression without additional means of fixing shall be deemed to be secure against unintentional disconnection if the overlapping length is not less than 150 mm.

7.3.2 Overlap of loose base jacks and head jacks with tube

The overlap length of the jack in the tube, l_0(see 9.3.2), shall be either 25 % of the jack length, $l_1$or 150 mm, whichever is the greater.

7.4 Flexibility of prefabricated support towers

A prefabricated support tower shall have a design capacity, R_d^*, of 90 % of its normal design load bearing capacity, R_d, when a differential settlement, δ_s, has been imposed or when a thermal movement of the supported construction has caused a horizontal movement, δ_t (see Figure 1), which the tower shall accommodate.

The value of the settlement, δ_s, shall be the lesser of 5 mm and that calculated from equation (1); the maximum value of the thermal movement shall be calculated from equation (2) taking the lesser of the two values of δ_s from the previous examination.

$$\delta_s = 2{,}5 \times 10^{-3} \times l \quad (1)$$

$$\delta_t = \delta_s \times h/l \quad (2)$$

where:

R_d is the normal design value of the load bearing capacity;

R_d^* is the design value of the load bearing capacity after differential settlement or thermal movement has occurred;

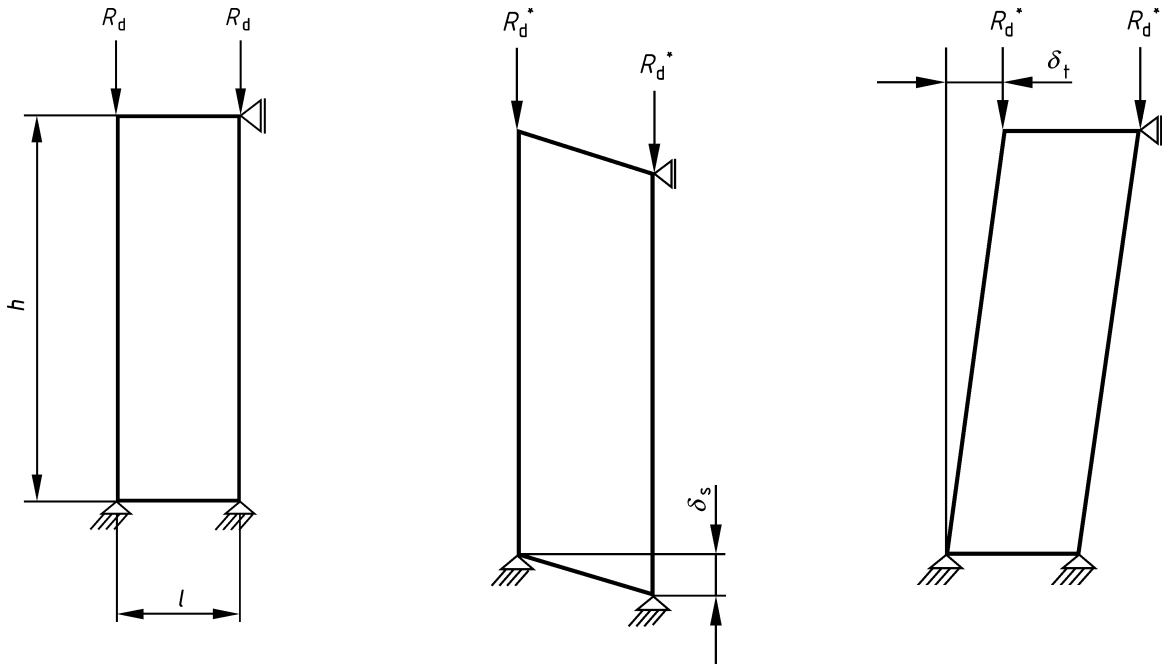
h is the overall height of the tower,

l is the horizontal base of the support structure,

δ_s is the differential settlement,

δ_t is the horizontal movement caused by temperature.

NOTE This requirement for flexibility is intended to enable towers to be used in typical site conditions.



a) Theoretical system b) Differential settlement c) Thermal movement

NOTE See 7.4 for symbol definitions.

Figure 1 — Relative deflections due to differential settlement or restraint

7.5 Foundation

7.5.1 Basic foundation requirements

The structure shall be supported directly from one or more of the following:

— a sub-structure provided for the purpose;

— the surface of the existing ground, e.g. rock;

— a partly excavated and prepared surface, e.g. in soil;

— a permanent structure which already exists.

Except where the conditions described in 7.5.2 apply, design shall follow normal rules taking account of the expected life of the structure.

7.5.2 Support without any embedment in the ground

For a spread foundation, topsoil shall always be removed.

The foundation shall not be placed directly on such a levelled surface without embedment unless all of the following conditions are met:

— the foundation is made secure against degradation by surface water and ground water during the life of the falsework;

NOTE 1 This may be done by providing drainage or protecting the surface with a concrete skin.